

**D R O U G H T
R E S P O N S E
P L A N**



**Denver Water
February 2002**

TABLE OF CONTENTS

◇	EXECUTIVE SUMMARY	1
◇	INTRODUCTION	6
	<i>STRUCTURING A COMPLETE PLAN.....</i>	<i>6</i>
	<i>DEFINING DROUGHT.....</i>	<i>6</i>
	<i>SETTING A GOAL.....</i>	<i>7</i>
	<i>OFFERING SOME BACKGROUND.....</i>	<i>8</i>
◇	SECTION ONE: WATER SUPPLY AND USE	9
	<i>SUPPLY</i>	<i>9</i>
	<i>USE</i>	<i>10</i>
	<i>QUALITY</i>	<i>13</i>
◇	SECTION TWO: STRATEGIES AND A DROUGHT RESPONSE OUTLINE	14
	<i>STAGING RESPONSES</i>	<i>14</i>
	<i>INCREASING WATER SUPPLY</i>	<i>14</i>
	<i>REDUCING WATER USE</i>	<i>15</i>
	<i>TRIGGERING ACTION</i>	<i>17</i>
	<i>TIMING DROUGHT ASSESSMENTS AND DECLARATIONS.....</i>	<i>18</i>
	<i>HELPING CUSTOMERS PLAN AHEAD.....</i>	<i>19</i>
	<i>TRIGGERING ACTION: TO WAIT OR NOT TO WAIT?</i>	<i>20</i>
	<i>OUTLINING THE DROUGHT RESPONSE.....</i>	<i>22</i>
	Mild Drought Response	23
	Moderate Drought Response.....	25
	Severe Drought Response	27
◇	SECTION THREE: PUBLIC OUTREACH.....	30
	<i>LISTENING AND TALKING</i>	<i>30</i>
	<i>MAINTAINING CREDIBILITY</i>	<i>31</i>
	<i>MAKING THE ROUNDS WITH EARLY INFORMATION</i>	<i>31</i>
	<i>INVOLVING THE PUBLIC IN DROUGHT RESPONSE DECISIONS</i>	<i>32</i>
	<i>WATCHING FOR DROUGHT.....</i>	<i>33</i>
	<i>CONSIDERING POLICIES DURING DROUGHT.....</i>	<i>34</i>
	<i>STAGING PUBLIC OUTREACH EFFORTS</i>	<i>35</i>
	Mild Drought	35
	Moderate Drought.....	36
	Severe Drought	37
◇	SUMMARY.....	37
◇	GLOSSARY OF TERMS	38
◇	INDEX.....	40

◇ **APPENDIX**

The Drought Response Plan Technical Appendix contains background information used to prepare this Drought Response Plan. The Appendix contains the following chapters and is available by calling Denver Water's Planning Division at (303) 628-5030.

Chapter 1: Live-on-Inflow Analysis

Chapter 2: Drought in the 1950s

Chapter 3: History of Water Use Restrictions

Chapter 4: Supply Augmentation Alternatives

Chapter 5: Reducing Deliveries to Outside City Contract Holders

Chapter 6: Collection System Operations During Drought

Chapter 7: Drought Response Model

Chapter 8: Drought Revenue Management

◇ EXECUTIVE SUMMARY

Drought is a natural phenomenon that has recurred at varying intervals throughout history, but that is curiously difficult to define. Denver Water defines drought as an extended period of below-average precipitation and/or stream flow that stresses our customers' water supply. For planning purposes, Denver's water supply strategy is to have enough water to meet unrestricted customer usage during a period similar to the 1950s' drought. Unfortunately, no one can predict how long droughts will last or if they will be worse than those used in our calculations. Therefore, even though our water supply currently exceeds our use, we must be prepared to recognize drought conditions early and respond appropriately. Our prime drought response goal is to budget water use so that supply will be available for the most essential uses for the drought's duration. Accordingly, we have developed this Drought Response Plan (DRP) to provide our Board of Water Commissioners with a set of options to consider in dealing with drought. The DRP addresses three areas—water supply and use, strategies and potential drought response, and public outreach. Each is discussed in more detail below.

Water Supply and Use

Denver Water defines firm yield as the estimate of the amount of water available from its collection system to dependably meet annual average demand without having to restrict water use. The firm yield of Denver's water system is estimated at 375,000 acre-feet (AF) of water (approximately 122 billion gallons). The current average annual water use in Denver Water's service area is approximately 285,000 AF.

Weather is usually the single biggest factor affecting use. Other factors affecting use include population growth and the effects of Denver Water's long-term water conservation effort.

Strategies and Potential Drought Response

The DRP is based on three levels of drought, each of which is triggered by the expected or actual reservoir storage levels on July 1 of any given year.

Drought Level	Trigger
Mild	Reservoirs are less than 80% full
Moderate	Reservoirs are less than 60% full
Severe	Reservoirs are less than 40% full

We chose July 1 as the trigger date because storage in Denver Water's system usually reaches its annual maximum around that date. July 1 storage levels are forecast monthly from February through June every year, based on current snow pack, stream flow and storage levels. Because of the vagaries of weather, forecasts prior to April are not considered reliable. For this reason, Denver Water would probably not make a drought declaration prior to April.

This plan identifies two ways to respond to a drought: increasing water supply and decreasing water use.

Increasing Water Supply. Denver Water could augment its water supply from other sources. There are several options for doing this, each presenting its own set of intergovernmental and technical considerations. Among the possibilities:

- Call back water rights that we allow others to use.
- Pay a downstream water user to allow us to divert more water.
- Seek waivers from federal and state agencies to allow us to divert more water.
- Drill wells.
- Install pumps and pump otherwise unusable water from reservoirs.
- Implement clauses in legal documents allowing us to draw reservoir storage below minimum levels.

We discuss these possibilities in more detail later in this document.

Decreasing Water Use. Denver Water's prime drought response is to budget water use so supply will be available for the most essential uses for the drought's duration. There are a wide variety of options that could be used to decrease water use. In general, we expect that reductions would be voluntary during a mild drought, with mandatory measures being phased in if drought conditions become more serious. We believe it is important to ensure that any discomfort, difficulty or potential loss is shared as equitably as possible across all customer classes. In the event of a prolonged drought, Denver Water staff and the Citizens' Advisory Committee would seek customer ideas and preferences in order to help the Board of Water Commissioners select and prioritize drought response measures.

Possible measures include:

Mild Drought (target of 10 percent reduction)

- Initiate campaign to alert public to drought.
- Notify Denver Water Distributors of the Board's action and time frame for implementing drought response measures.
- Implement water restriction clauses in fixed-delivery contracts.
- Acquaint customers with measures they can expect if drought continues or intensifies.
- Contact special interest groups with heavy water use to get their ideas and support.
- Publish suggestions for temporarily reducing water use.
- Ask customers to voluntarily reduce outdoor water use using their own methods and Denver Water suggestions.
- Discourage changes in landscape or establishment of new landscape.
- Consider a rate increase to recover lost revenues.
- Require Master Meter Distributors to activate similar programs with their customers.

- Encourage entities that receive water from Denver Water under other contractual terms to activate similar programs with their customers.
- Monitor drought response effectiveness, recommend adjustments quarterly to the Board of Water Commissioners, report to the public regularly, and document results annually.

Moderate Drought (target of 30 percent reduction)

- Continue all measures initiated in the mild drought stage.
- Request all government entities to reduce their own water use by 35 percent to demonstrate leadership in dealing with the crisis, and then publicize the results.
- Generate publicity about the Drought Response Hotline, and prepare Denver Water personnel—particularly customer service employees—to respond to drought-related questions and give information.
- Train and assign Denver Water field and customer service personnel to:
 - Police outdoor water use.
 - Issue warnings.
 - Impose penalties for water waste, violations of any permits and noncompliance with restrictions.
- Restrict outdoor water use to specified hours and days for all customers.
- Prohibit planting new lawns from seed or sod.
- Increase rates to increase financial incentives for reducing water use.
- Intensify public discussion about water use priorities and ways to reduce water use, and involve the Denver Fire Department more intensively in these public discussions.
- Encourage customers to voluntarily limit or eliminate non-essential water uses and provide guidelines.
- Publicize heroic efforts of individuals and business customers as examples of leadership.
- Highlight unusually high use on customers' bills.
- Require water use surveys (comprehensive water use analyses) for high-volume water users in all customer classes, advise them on ways to reduce water use and, where appropriate, provide retrofit devices.
- Provide water audits and recommend drought response measures for all large irrigated public areas.
- Publish a do-it-yourself "water waste reduction" brochure for households and aggressively promote it by stuffing it into water bills, putting it on Denver Water's web site, and using other effective distribution methods.
- Step up Denver Water's ongoing leak detection and repair activities for water pipes and mains under streets.
- Require leak surveys in Master Meter districts.
- Restrict car, truck and boat washing on dealers' lots.
- Restrict personal vehicle washing.

Severe Drought (target of 50 percent reduction)

- Continue all measures initiated in mild and moderate droughts.
- Intensify public information to reinforce the need for extreme measures (generate awareness of drought status, response, policy recommendations, requirements and penalties).
- Generate more intense public discussion and media involvement about water use priorities, ways to cut water use while minimizing impacts on landscape, and recovery planning.
- Limit customer service personnel to essential functions and assign customer service representatives to increase enforcement of drought measures.
- Increase water rates to increase financial incentives for using less water.
- Provide information and assistance to customers planning for post-drought landscape revival or replacement.
- Impose a moratorium on new taps.
- Eliminate all fire hydrant uses except those required for public health and safety.
- Reduce indoor water use:
 - Eliminate serving water in restaurants except on request.
 - Require all hotels, motels, inns and bed and breakfast establishments to have only showerheads meeting maximum flow rates of 2.5 gallons per minute and faucet aerators meeting maximum flow rates of 2.2 gallons per minute.
 - Assist city and county health departments in distributing guidelines for using gray water where legal and appropriate.
 - Adjust temperatures in buildings with water-cooled air conditioners to require less water.
 - Promote the reduction of water-cooled air conditioning.
- Intensify reductions of outdoor water use:
 - Increase penalties for wasting water, violating any permits or ignoring restrictions.
 - Eliminate street cleaning, sidewalk and driveway washing—except where spills of toxic or hazardous substances or where public health and safety issues can only be resolved by washing the impermeable surface.
 - Eliminate washing sidewalks or driveways and any other hard surfaces with hoses.
 - Eliminate curbside car/truck washing by all customers.
 - Eliminate car/truck washing on dealers' lots.
 - Eliminate filling private swimming pools.
 - Reduce the use of or close public and private swimming pools and other water recreation facilities.
 - Require that ornamental fountains in buildings and parks be turned off.
 - Impose restrictions in landscape water use in proportion to the severity of the drought.
 - Restrict all outside irrigation, including park and golf course irrigation.

- Restrict greenhouse water use and watering of nursery stock at tree farms.
- Restrict irrigation of private and community food, herb and flower gardens.
- Restrict water use for fertilization, pesticide and herbicide application by commercial enterprises or by individuals.
- Prohibit all new landscaping including planting of trees and shrubs.
- Prohibit outdoor water use (as a last resort in an extremely severe drought) except for subsistence irrigation of trees and shrubs.
- Publish more information on ways to minimize landscape damage and loss.

Public Outreach

During a drought, it is essential that Denver Water communicate effectively not only with our customers, but also with other area water suppliers, local governments, Western Slope representatives and other groups who may be affected by Denver Water's drought response.

Denver Water currently has a Citizens' Advisory Committee (CAC) that monitors the agency, invites public involvement and advises the Board of Water Commissioners on policies. The CAC's Drought Response Task Force encouraged the writing of this plan. During a drought, the Task Force would be expanded to provide feedback on drought plans and policies.

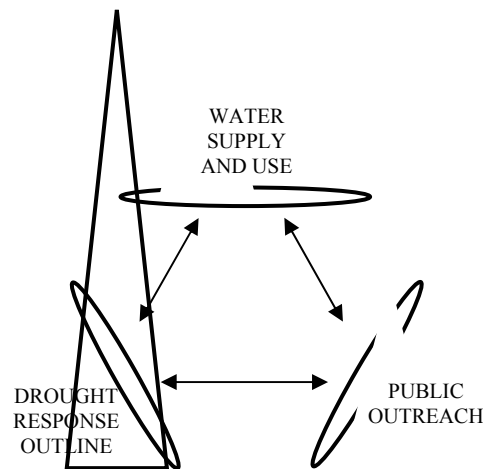
Summary

While the options listed in the DRP are based on lessons learned here and from other water utilities during past droughts, it is important to understand that every drought is different and that the Board of Water Commissioners will adjust and refine measures based on actual drought conditions. This plan is intended to help staff, customers, stakeholders and the Board be better prepared when a drought occurs.

◇ INTRODUCTION

Structuring a Complete Plan

As this document developed, it became clear that good drought response planning focuses on three activities: a great deal of knowledge about **water supply and use** history and trends; a complete inventory of **drought response options**; and a willingness to **listen and talk with people** about responses to drought.



None of the three aspects of this planning triangle is more or less valuable than the others; each relies on the others for support to create a complete form of response. The reader will find the triangle symbol throughout this plan as a graphic reminder of what this effort is all about.

Defining Drought

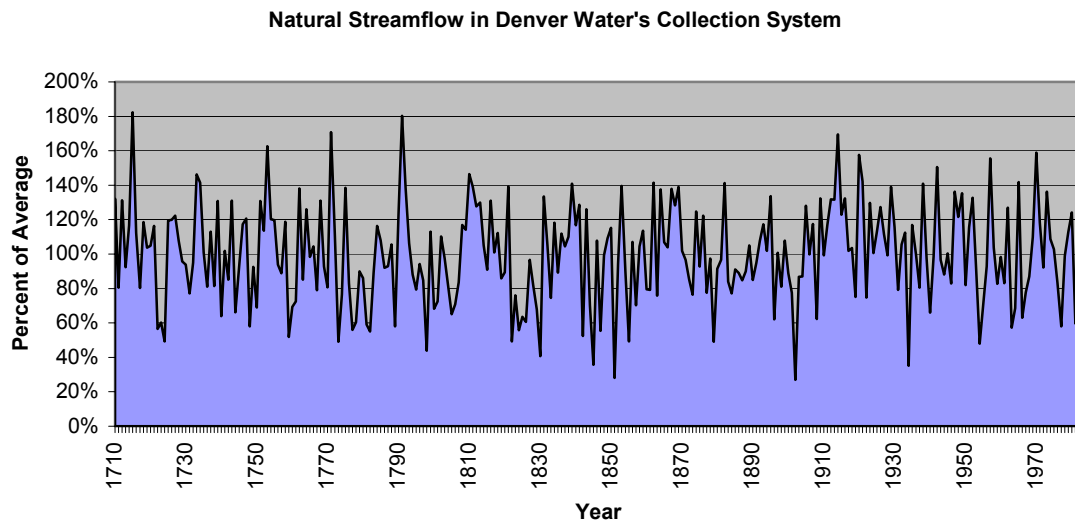
Any drought response plan must begin with discussion of a deceptively simple question: What is drought?

Many people think of drought as a summer with little rain. A dictionary definition of drought is “a natural condition caused by less-than-average moisture over a period of time.” The National Drought Mitigation Center defines drought as “the time period in which a shortfall of precipitation creates a shortage of water, whether for crops, utilities, municipal water supplies, recreation, wildlife or other purposes.” By comparison, a

water-providing organization would see drought as a continued lack of moisture that could result in water supply shortages.

Denver Water defines drought as an extended period of below-average precipitation and/or stream flow that stresses its customers' water supply. When the amount of water flowing into streams and then into reservoirs is less than average for a long period, Denver Water will more closely monitor its water supply outlook. If continued low stream flows stress water supplies, Denver will start working with its customers using this Drought Response Plan.

The following plot depicts the variability of natural streamflow in our raw water collection system. Droughts are a recurring natural phenomenon, as the troughs in the plot indicate.



Setting a Goal

Denver Water's prime drought response goal is to budget water use so that supply will be available for the most essential uses for the drought's duration.

Denver's system is designed to dependably meet the needs of all of its customers through hydrologic conditions similar to those of the last 50 years without supply shortages. Unfortunately, no one can predict how long drought conditions will continue once they begin. Timely response—neither too early nor too late—is Denver Water's goal.

A Word of Caution

This Drought Response Plan outlines the procedures by which Denver Water could manage water supply and use on behalf of the community while responding to customer priorities. Each drought will be different, so it is not practical to develop a set of hard and fast rules that apply to all droughts. Rather, this plan is a menu of policy options for the Denver Water Board as its five members make decisions in the course of a particular drought. Readers should not assume the Denver Water Board will follow pre-determined procedures. Instead, the Board will tailor its drought response to the actual drought conditions.

Offering Some Background

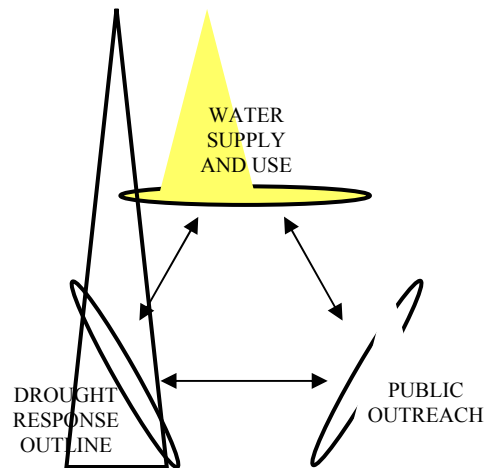
Before drafting this plan, Denver Water's Planning Division examined a range of drought scenarios, quantified the severity of Colorado's drought of the 1950s, revisited the history of water use restrictions in Denver, reviewed the lessons of past droughts, and projected options for getting more water in times of drought. These reports and analyses are published in a separate technical appendix for interested readers.

Some options listed here may seem either so obvious or unlikely as not to warrant inclusion. While every emergency presents its own peculiar issues, a plan that lists as many options as possible helps ensure fundamentals are being accomplished while unique configurations of events are addressed. The objective is to perform well in a drought.

The Drought Response Plan is in three sections:

- **Water Supply and Use** describes water supplies currently on hand and normally used by Denver customers.
- **Strategies and a Drought Response Outline** discusses possibilities for getting more water in times of drought and for reducing water use.
- **Public Outreach** outlines options for seeking public suggestions and involvement, as well as keeping customers informed before, during and after a drought.

◇ SECTION ONE: WATER SUPPLY AND USE



Supply

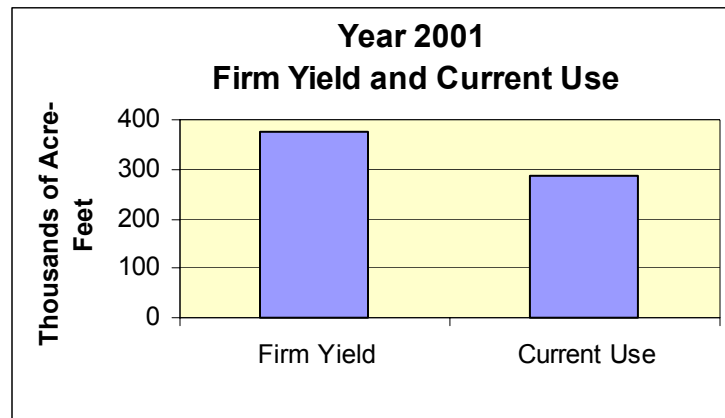
A water utility often expresses available supply as “firm yield.” **Denver Water defines firm yield as the estimate of the amount of water available from its collection system to meet annual average demand dependably without having to restrict water use.** A key word in this definition is "average" because, in practice, customers use more water when the weather is warm and dry than when it is cool and wet. Furthermore, weather swings can be substantial from year to year, and from decade to decade—affecting both water supply and use.

Estimates of firm yield focus particularly on historic periods of low precipitation and stream flow to predict how much water, or yield, can be expected from the system year in and year out.

Records of Denver's past drought periods reveal these key factors:

- The number of consecutive years of lower-than-average stream flows into reservoirs.
- Customer water use patterns, including those at highest levels.
- The rate at which total reservoir storage decreases before recovering to normal levels after a drought.

Firm yield is an estimate rather than an exact calculation. Of the many factors, weather is perhaps the most inexact aspect of firm yield estimates. It is possible that the Denver area could experience a drought more severe than has ever been recorded, and it could stress the water supply system even more than was accounted for in the firm yield estimates. However, for what can be reasonably foreseen based on half a century of experience, the firm yield estimate appears to be a relatively safe, prudent way to view customers' water supply for drought planning purposes.



The firm yield of Denver's water system is estimated at 375,000 AF per year. An AF is about 326,000 gallons of water—an amount that would cover one acre of land to a depth of one foot, or a football field (or a soccer field) to a depth of 10 inches. This amount of water serves the needs of about four people in a year at their homes (or 1.7 homes with 2.35 people per household) and their offices, parks recreation centers, shopping centers, etc.



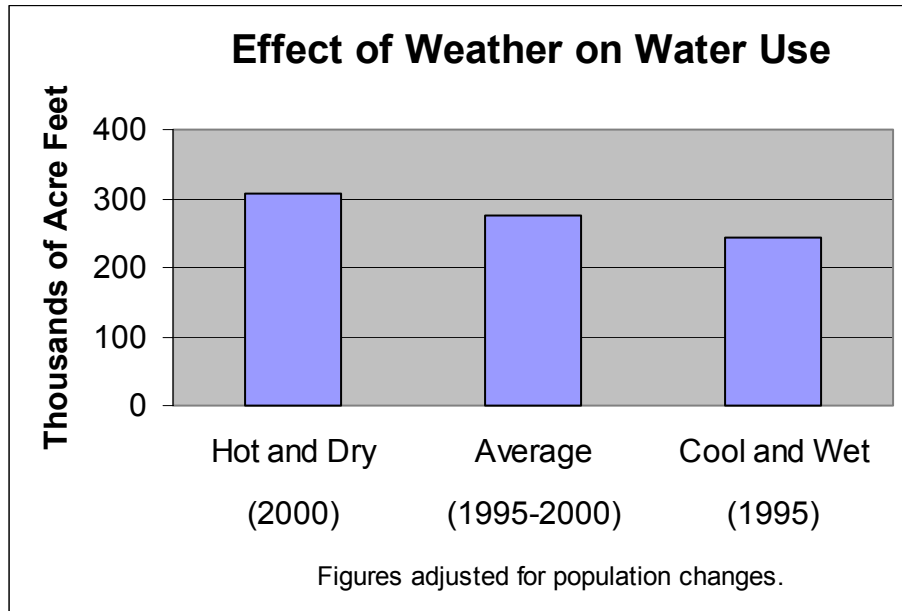
A youth soccer field flooded to a depth of 10 inches would be about 1 AF of water. This amount serves the needs of about four people in a year, at their homes and their water use at offices, parks, recreation centers, shopping centers, etc.

Use

Water use is the amount of water customers consume; it is subtly different from water demand. Water demand is the amount customers would use without any restrictions placed on that use. Demand can be different than use because demand reflects an

unrestricted use of water. Everyday conservation of water is not considered a restriction of water use.

Weather, population and the community's water conservation efforts during normal supply periods have affected Denver customers' water use through the years. In communities without population increases or a long-term water conservation effort, weather alone accounts for significant swings in use from year to year.



All indications are that Denver's customers are conserving water. In the mid 1970s, Denver Water started to work more aggressively with customers to conserve water. By 1979, the Denver Water Board had adopted a formal Water Conservation Plan and set goals for reducing water use. Among ongoing efforts to meet the Board's goals were:

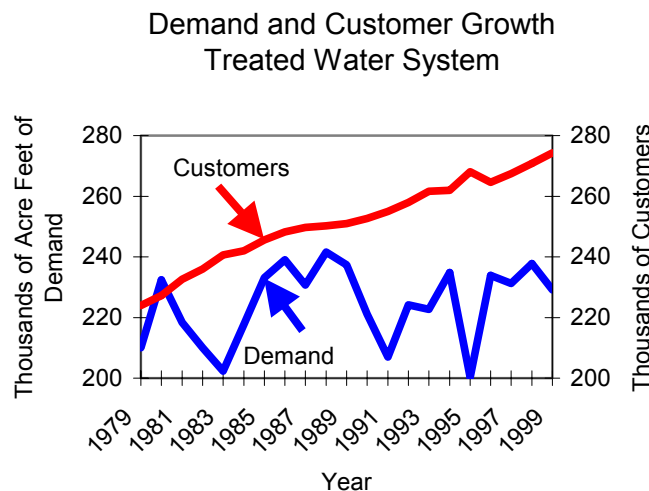
- Promoting water-efficient landscaping.
- Irrigating lawns only every three days instead of every day.
- Installing water meters for every household account.
- Offering rebates for ultra-low-volume toilet installations.
- Visiting houses and apartments to show owners water-saving fixtures and practices.
- Responding to the public on a water conservation hotline.
- Presenting K-12 classroom sessions on water.
- Establishing new rate structures.
- Undertaking aggressive leak detection and repair on underground water pipes.
- Advertising conservation awareness each year.

The results: Denver Water customers as a whole have steadily cut their expected water use by more than 10 percent since 1980. (This is 12 percent of treated water demand.)

Much of this reduction has come from residential customers, and much of their savings has resulted from metering. While Denver Water is considered a leader among water utilities in non-crisis conservation techniques, much remains to be understood about both the art and science of wise water use. There is a need for long-term research on questions such as: Which particular efforts create the most sustainable water savings with the least investment? How much can a utility rely on a conservation-based pattern of use to plan a community water supply? How does non-crisis water conservation affect the ability of customers to further reduce use during a drought?

The current average annual water use of Denver Water's service area is estimated at 285,000 AF. Denver Water serves 1 million people in 325 square miles across the metropolitan area, including the City and County of Denver, Wheat Ridge, Littleton, Broomfield, Arvada, most of Lakewood, and large portions of unincorporated Jefferson, Arapahoe and Adams counties. Excluding Denver International Airport and Green Valley Ranch, approximately 15 percent of the land in Denver's service area is zoned but as yet undeveloped. In addition, large tracts of land in Denver's service area—the lower Platte Valley, Lowry Air Force Base and Stapleton Airport among them—remain in transition to other uses.

To track water use and savings, Denver Water looks at water use by customers over the years and plots those numbers in comparison to the population growth in the service area. The graph below shows 20 years of comparisons. The two biggest dips, 1983 and 1995, were very wet years.



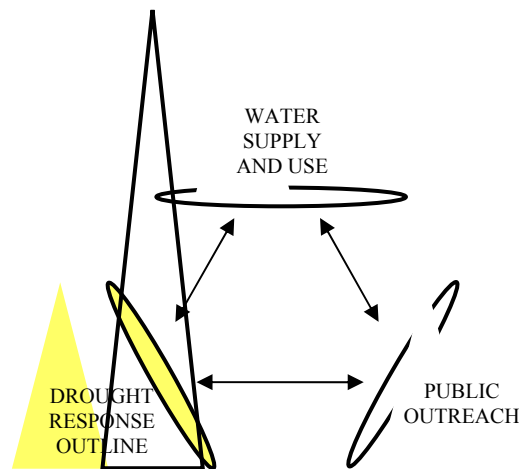
The good news is that on average, customers appear to be reducing water waste. The bad news is that it may take much more effort by customers and by water providers to achieve reductions during a severe drought.

Quality

Regardless of the amount of water available, Denver Water is committed to the highest possible water quality. Even during a drought, Denver Water will maintain its high standards for water quality in the treatment plants, in the distribution pipes and in the pipes serving customers.

Some customers may sense a contradiction when they see Denver Water trucks flushing stale water from dead-end pipelines during a drought. This is part of the water quality maintenance program and will be continued during drought. Every attempt will be made to redirect the stale water to effective non-potable uses so that no water is really “wasted.”

◇ SECTION TWO: STRATEGIES AND A DROUGHT RESPONSE OUTLINE



Staging Responses

Denver Water's Drought Response Plan is progressive. The plan first anticipates what can be done during mild droughts and moves through increasingly more complex drought levels and possible actions.

Three drought levels are named in this plan—mild, moderate and severe. They are tied to decreasing reservoir storage. As reservoir storage declines, work on reducing water use and/or adding to the water supply increases. Some drought response measures listed, particularly those for mild episodes, would require minimal customer effort. Measures become mandatory, more costly and sometimes intrusive only as the drought progresses. Please note the chart on page 22 for a better understanding of reservoir levels, drought triggers and savings needed.

Increasing Water Supply

Denver Water could respond to a drought by adding to its customers' water supply from other sources. Each option presents its own unique intergovernmental and technical issues and must be considered individually.

Among the possibilities:

- △ **Call back water rights that others are allowed to use in non-drought periods.** For example, under contract, Denver Water allows ranchers to divert its Williams Fork water rights into the Big Lake Ditch. Under certain contract conditions in dry periods, Denver can prevent the ranchers from diverting this water, thereby causing more water to flow into Williams Fork Reservoir and increasing the system yield.
- △ **Pay a downstream water user to allow Denver Water to divert more water.** An example of this alternative is Denver Water's contractual option to pay the Public Service Company (Xcel Energy) to not place its Shoshone Power Plant river "call" on the Colorado River. A river call is an administrative mechanism used by an owner of a senior downstream water right to prevent or reduce water use by an owner of a junior upstream water right. Without the Shoshone call in effect, Denver may be able to divert more water in a prolonged drought.
- △ **Seek waivers from federal and state agencies to allow Denver Water to divert more water.** Denver must allow minimum amounts of water to pass beyond some of the locations where water may be taken out. However, by contract, some of these minimum amounts may be reduced during a drought.
- △ **Drill wells.** Denver Water is in the process of obtaining the legal right to use the non-tributary groundwater deep beneath Denver. Once the right is obtained, wells could be drilled to withdraw this water. It also may be possible to drill non-tributary wells in other locations.
- △ **Install pumps and pump otherwise unusable water from reservoirs.** Normally water flows from reservoirs and other water storage facilities via gravity. However, water in lower portions of these facilities often is at a level below the pipe that carries it by gravity to a water treatment plant. To access this water, pumps could be used to pull the water up and into the transmission pipe.
- △ **Implement clauses in legal documents allowing Denver Water to draw reservoir storage below minimum levels.** As an example, the level at Chatfield Reservoir can be drawn below its normal minimum if the drought were considered an emergency.

Reducing Water Use

Denver Water also can respond to drought by reducing water use. Because of the uncertain nature of some options for increasing the water supply during a time of drought, it is likely Denver would need to rely on reducing water use, especially in severe circumstances. There are several key philosophies affecting reduced water use:

△ **At the mild drought stage, water use reductions would be voluntary.** Denver Water would see its responsibility as making the public aware of the drought and preparing customers for more demanding measures if the drought continues. Rate increases may be needed to offset lost revenue caused by reduced water use.

△ **If drought conditions become more serious, it will be important to ensure that discomfort, difficulty and potential sacrifice are shared and not borne by just one type of customer.** In considering drought response measures, Denver Water acknowledges the importance of maintaining the economic viability of the community as much as possible. This includes requesting similar levels of sacrifice for commercial and industrial customers, and a generally similar level of sacrifice for residential customers. It also means reserving sufficient water for emergency public health and safety uses.

This set of guidelines includes keeping valuable landscaping alive and healthy if possible. This plan delays the most stringent landscaping measures until drought is severe. Measures for reducing water use during mild and moderate droughts tend to be temporary; these steps likely will not harm existing, hearty landscaping, especially previously established Xeriscapes. However, in the unlikely event that drought becomes severe and prolonged, replacing high-water use lawns, plants and trees probably would be necessary after the drought. In general, indoor domestic use takes priority over outdoor irrigation; saving trees and shrubs takes priority over saving lawns; and basic health and safety supersedes all other considerations.

One scenario would be to strive for similar levels of sacrifice by all water users. Another scenario might be to strive for graduated percentage reductions by all users except those in hospitals, clinics and fire-fighting situations. The Board will determine what actions to follow based upon conditions at the time.

△ **Particularly in later drought stages, water use austerity measures will depend on how successfully targets have been achieved to that point.** For this reason, the weather, water supply and effectiveness of steps to cut water use must be closely evaluated throughout the drought period to provide a solid foundation for decision-making.

△ **Customer ideas and preferences are important in helping the Denver Water Board select and prioritize drought response measures.** The results of a prolonged drought would be widespread and diverse. A long drought would significantly affect lifestyles, livelihoods and property. Managing water use, particularly during times of strain, requires constant customer confidence and involvement. Denver expects public exchange will be carried out through its Citizens' Advisory Committee and by other outreach efforts by Denver Water. One option might be to hold a drought response exercise, a type of "dress rehearsal," for Denver Water staff and stakeholders.

Triggering Action

Two questions are central to building a staged drought response:

- △ **When** should a mild, moderate or severe drought be declared?
- △ **How much** water must be saved?

Given Denver Water's specific situation and history, the first drought trigger was based on two prime factors:

Drought declarations and responses should be based on the July 1 total water system storage.



If expected or actual July 1 total water system storage is below 80 percent full, action should be taken.

July 1 was chosen because storage in the Denver Water system usually reaches maximum by about that date each year. The largest part of the snowmelt is complete, and most of the high-water-use days of summer are ahead.

Eighty-percent full reservoirs is the first trigger for two reasons: First, 80 percent is the amount of water that, with increasingly cautious use over time, is projected to see Denver Water's existing customers through a drought more severe than the one experienced in the 1950s; second, the 80 percent mark avoids inconveniencing customers too often. As growth occurs and/or our firm yield changes, this threshold may need to be changed.

This "fullness of all reservoirs" approach allows for normal or generous stream flow in one area of the Denver water system to compensate in the overall water storage picture for poor stream flow in another area. Denver Water customers benefit from a water system flexible enough to take advantage of circumstances such as these.

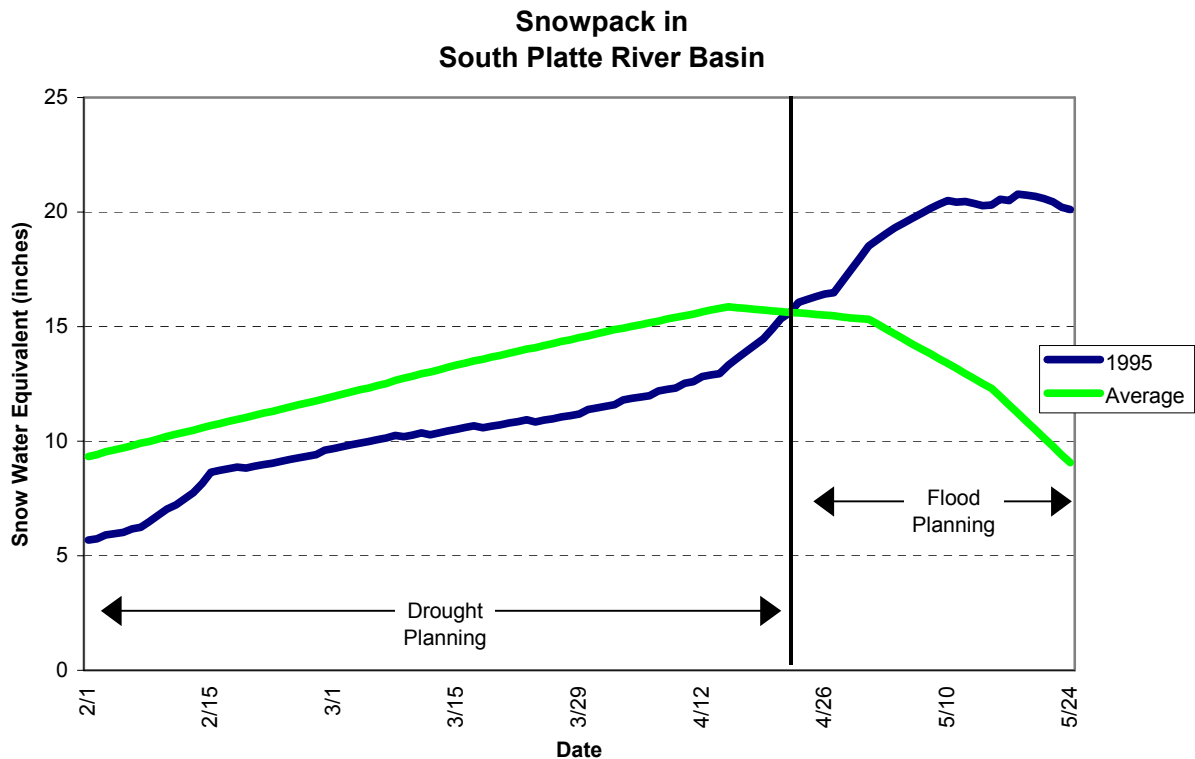
Timing Drought Assessments and Declarations



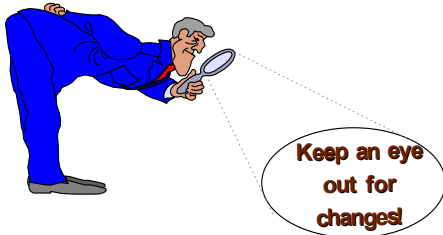
Denver Water will make its first official assessment as soon as we can predict with reasonable certainty the total water storage in Denver reservoirs on July 1.

July 1 storage levels are forecast during the first week of February, March, April, May and June. The predictions are based on measurements of snow pack, stream flow and amount of water already in storage on the forecast date. As one would expect, the ability to predict July 1 storage improves as July 1 approaches. Typically, forecasts of July 1 reservoir storage are not reliable until the April forecast. **Denver Water would probably not make a drought declaration before April except under unusual circumstances.**

Sometimes a drought appears at hand, but Mother Nature has other ideas. For example, the following plot shows what happened in 1995:



In this approach, Denver Water considered the relative advantages of alerting customers to drought earlier rather than later in the season. The greatest opportunity to save water is May through September (the lawn watering season); therefore, waiting until July 1 to make a declaration loses the opportunity to save water in the high-use months of May and June.



Once a drought is declared, Denver Water wants its customers to know that Denver will continue to carefully watch the day-to-day changes in stream flow, snow pack and water use until the drought is over.

If conditions change after an initial drought declaration, the declaration of drought can be lifted or the level of the drought response can be adjusted. Denver Water's actions must be adequate to deal with the lack of water, but not cause unnecessary hardship for its customers.

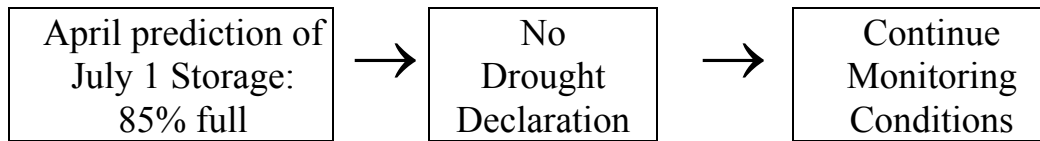
The following ranges for drought levels are recommended:

If Predicted or Actual July 1 Storage is Below. . .	Declaration Would Be. . .
80 percent full >>>>>	Mild Drought
60 percent full >>>>>	Moderate Drought
40 percent full >>>>>	Severe Drought

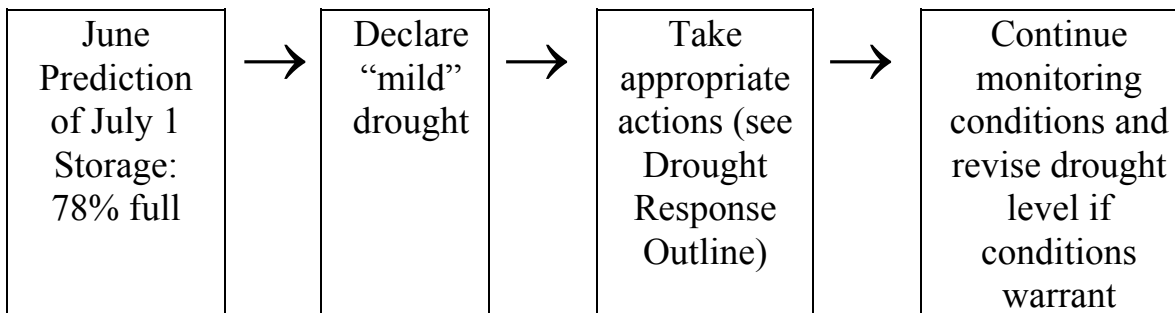
Helping Customers Plan Ahead

Unfortunately, Denver Water is no better at predicting weather than anyone else. Forecasting a drought or even knowing with certainty when one exists is problematic. For example, in a year with a low snow pack, it cannot be determined whether it is the first year of a three-, five- or 10-year drought, or merely a dry year that falls somewhere in a series of average to wet years. Denver Water cannot offer drought prediction, but it can keep its customers advised of the latest information on water supplies so they may make their plans. To get the latest information on reservoir levels, call 303-628-6510 or visit Denver Water's Web site at www.denverwater.org.

Here is an example of how the drought assessment process would work. If, in April of some year, Denver Water predicts its reservoirs will be 85 percent full on July 1, then a drought declaration would not be recommended.



Now suppose that May is unusually dry and the June prediction of July 1 storage is 78 percent full. In this case, Denver would likely declare a “mild drought” and take appropriate action.



If the supply situation became significantly worse, the drought declaration would likely be changed to “moderate.” Generous rain, on the other hand, likely would cause the drought declaration to be lifted.

Triggering Action: To Wait or Not To Wait?

Denver Water staff spent a great deal of time analyzing and debating the advantages and disadvantages of taking action early in a possible drought versus a more delayed response. These are the tradeoffs:

<i>Early action...</i>	<i>Delayed action...</i>
Customers frequently asked or required to reduce water use.	Customers infrequently asked or required to reduce water use.
Reservoirs stay relatively full .	Reservoirs are less full .
A severe drought can be withstood before running out of storage water.	A less severe drought can be withstood before running out of storage water.

A primary focus was the potential hardships caused by reducing water use and drawing reservoirs to lower levels. Reducing water use could affect metro-area businesses and damage water-intensive landscapes. Low reservoirs reduce or prevent recreation, affect

the environment and create aesthetic problems. In the final analysis, three questions were asked to judge proposed storage trigger levels:

- △ How severe a drought would the proposed levels enable customers to withstand?
- △ With these levels, how often and to what degree would customers be asked to reduce their water use?
- △ How low would reservoirs get?

To answer these questions, the following assumptions were made:

- △ Current average annual demand is 285,000 AF.
- △ Current firm annual yield is 375,000 AF.
- △ Through close cooperation, Denver Water and its customers would cut annual unrestricted water use by 10 percent during a Mild Drought, 30 percent during a Moderate Drought and 50 percent for a Severe Drought.

These water use cuts are estimated on the basis of how customers use water during normal periods, as well as how water was used during past dry periods. These targets for reducing water use are truly targets; to refine them, further discussion with customers is needed, more research is required on everyday water conservation activities, and approval must be given by the Denver Water Board.

Drought Triggers

Reservoir Contents	Drought Level	Reduction Target
80%	Mild	10%
60%	Moderate	30%
40%	Severe	50%

Given these assumptions, the answers to the three questions are as follows:

How severe a drought can the Denver system withstand?

- △ The proposed levels would enable Denver Water and its customers to weather a drought more severe than the 1950s drought. For example, at the current level of water use, we could withstand eight consecutive 1954-type years before running out of water. (1954 is generally considered the worst

year of the 1950s drought.) During the 1950s drought, the combination of high summer temperatures and low stream flows caused significant water use disruptions including mandatory lawn watering restrictions. As Denver “grows” into the full use of its existing collection system, the number of consecutive 1954-type years that could be withstood will decrease unless the trigger levels and/or demand reduction targets are made more stringent.

How often and to what degree would customers be asked to cut water use?

- △ At current water supply and use levels, with the triggers given in this plan, the probability of a drought declaration in any one year is about 7 percent. As water use gets closer to Denver’s firm yield, drought declarations become more likely. System maintenance or repair activities that prevent Denver Water from storing all available water also would make a drought declaration more likely.

How low would reservoirs get?

- △ With the triggers given in this plan and assuming current water use amounts, the likelihood of Denver’s reservoirs getting as low as 1977-78 is about 7 percent. On July 1, 1977, Denver Water storage reservoirs were down to 78 percent of overall capacity; by April 1, 1978, they were 51 percent of overall capacity.

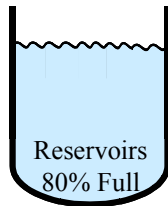
Outlining the Drought Response

The core of the Drought Response Plan is found in the Drought Response Outline beginning on the next page. This table displays and links progressive drought stages, water storage triggers, action options, and target water use cuts. In reviewing this table, keep in mind that:

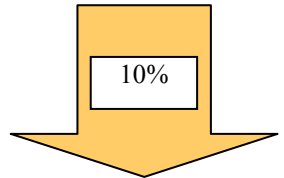
- △ Storage triggers refer to the fullness of storage reservoirs, either actual or predicted.
- △ Measures to increase water supply will be carefully considered at each stage.
- △ The table’s purpose is to guide discussion, not mandate action. The Denver Water Board will make decisions based on actual conditions.
- △ As supply and demand change, the menu of options available also may change.

Drought Response Outline

Mild Drought Response



Mild
Drought



July 1 Storage Trigger: Reservoirs less than 80 percent full
Use Reduction Target: 10 percent

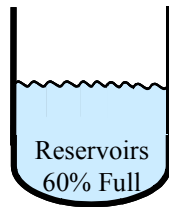
Menu of Possible Board Actions to Cut Water Use:

- ❖ **Initiate** campaign to alert public to drought.
- ❖ **Notify** Denver Water Distributors of the Board's action and time frame for implementing drought response measures.
- ❖ **Implement** water restriction clauses in fixed-delivery contracts.
- ❖ **Acquaint** customers with measures they can expect if drought continues or intensifies.
- ❖ **Invite** public discussion on water use priorities and ways to cut water use.
- ❖ **Contact** special interest groups with heavy water use (for example, water recreation groups) to get their ideas and support.
- ❖ **Publish** suggestions for temporarily reducing water use.
- ❖ **Ask** customers to voluntarily reduce outdoor water use using their own methods and Denver Water suggestions.
- ❖ **Discourage** changes in landscape or establishing new landscape.
- ❖ **Consider** a rate increase to recover lost revenues.

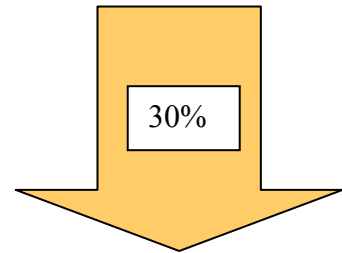
- ❖ **Require Master Meter** distributors to activate similar programs with their customers.
- ❖ **Encourage** entities that receive water from Denver Water under other contractual terms to activate similar programs with their customers.
- ❖ **Monitor** drought response effectiveness, recommend adjustments quarterly to the Denver Water Board, report to the public regularly, and document results annually.

Drought Response Outline

Moderate Drought Response



**Moderate
Drought**



July 1 Storage Trigger: Reservoirs less than 60 percent full

Use Reduction Target: 30 percent

Menu of Possible Board Actions to Cut Water Use:

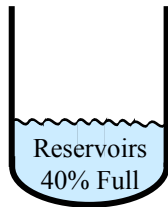
Note that recommended Guidelines are voluntary during Mild Droughts. However, some guidelines may become requirements during a Moderate Drought.

- ❖ **Continue** all measures initiated in the mild drought stage.
- ❖ **Request** all government entities to reduce their own water use by 35 percent to demonstrate leadership in dealing with the crisis, and then publicize the results.
- ❖ **Generate** publicity about the Drought Response Hotline; prepare Denver Water personnel—particularly customer service employees—to respond to drought-related questions and give information.
- ❖ **Train and assign** Denver Water field and customer service personnel to:
 - Police outdoor water use.
 - Issue warnings.
 - Impose penalties for water waste, for violations of any permits, and for noncompliance with restrictions.
- ❖ **Restrict** outdoor water use to specified hours and days for all customers.
- ❖ **Prohibit** planting new lawns from seed or sod.
- ❖ **Increase** rates to increase financial incentives for reducing water use.
- ❖ **Intensify** public discussion about water use priorities and ways to cut water use, and involve the Denver Fire Department more intensively in these public discussions.

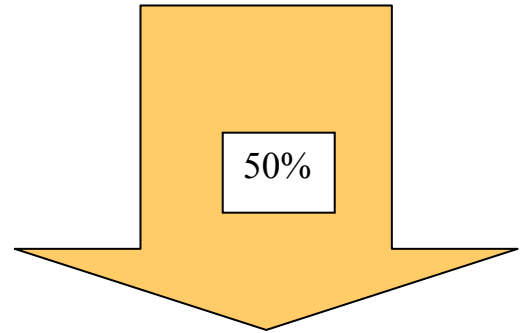
- ❖ **Encourage** customers to voluntarily limit or eliminate non-essential water uses and provide guidelines.
- ❖ **Publicize** heroic efforts of individuals and business customers as examples of leadership.
- ❖ **Highlight** unusually high use on customers' bills.
- ❖ **Require** water use surveys (comprehensive water use analyses) for high-volume water users in all customer classes, advise them on ways to reduce water use and, where appropriate, provide retrofit devices.
- ❖ **Provide** water audits and recommend drought response measures for all large irrigated public areas.
- ❖ **Publish** a do-it-yourself "water waste reduction" brochure for households and aggressively promote it by stuffing it into water bills, putting it on Denver Water's web site, and using other effective distribution methods.
- ❖ **Step up** Denver Water's ongoing leak detection and repair activities for water pipes and mains under streets.
- ❖ **Require** leak surveys in Master Meter districts.
- ❖ **Restrict** car, truck and boat washing on dealers' lots and in company fleets, both governmental and private sector.
- ❖ **Restrict** personal vehicle washing.
- ❖ **Monitor** drought response effectiveness, recommend adjustments quarterly to the Denver Water Board, report to the public regularly, and document results annually.

Drought Response Outline

Severe Drought Response



**Severe
Drought**



July 1 Storage Trigger: Reservoirs less than 40 percent full

Use Reduction Target: 50 percent

Menu of Possible Board Actions to Cut Water Use.

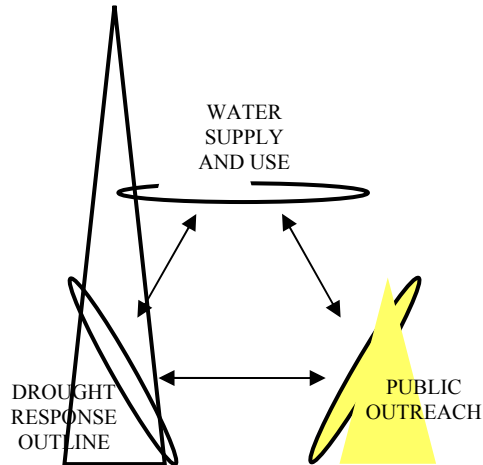
Note that recommended guidelines are voluntary during Mild Droughts and somewhat voluntary during Moderate Droughts. However, these guidelines may become requirements during a Severe Drought. The severity of the drought requires more reliance on required measures above the levels applied in a Moderate Drought.

- ❖ **Continue all measures initiated in mild and moderate droughts.**
- ❖ **Intensify** public information to reinforce the need for extreme measures; generate awareness of drought status, response, policy recommendations, requirements and penalties.
- ❖ **Generate** more intense public discussion and media involvement about water use priorities and ways to cut water use while minimizing impacts on landscape and recovery planning.
- ❖ **Limit** customer service personnel to essential functions and assign customer service representatives to increase enforcement of drought measures.
- ❖ **Increase** water rates to increase financial incentives for using less water.
- ❖ **Provide** information and assistance to customers planning for post-drought landscape revival or replacement; focus public attention on plant and tree species that have weathered drought better than most.
- ❖ **Impose** a moratorium on new taps.

- ❖ **Eliminate** all fire hydrant uses except those required for public health and safety.
- ❖ **Reduce** indoor water use:
 - **Eliminate** serving water in restaurants except on request.
 - **Require** all hotels, motels, athletic clubs, inns and bed and breakfast establishments to have only showerheads meeting maximum flow rates of 2.5 gallons per minute and faucet aerators meeting maximum flow rates of 2.2 gallons per minute.
 - **Assist** City and County Health Departments in distributing guidelines for using gray water where legal and appropriate.
 - **Adjust** temperatures in buildings with water-cooled air conditioners to require less water.
 - **Restrict** non-essential uses in industrial, commercial and institutional operations (bottling processes, metal fabrication, etc.).
 - **Promote** the reduction of water-cooled air conditioning.
- ❖ **Intensify** reductions of outdoor water use:
 - **Increase** penalties for wasting water, violating any permits or ignoring restrictions.
 - **Eliminate** street cleaning, playground, and sidewalk and driveway washing using hoses or machinery, except in instances of spills of toxic or hazardous substances, or where public health and safety issues can only be resolved by washing the impermeable surface.
 - **Eliminate** curbside car/truck washing by all customers.
 - **Eliminate** car/truck washing on dealers' lots and in company fleets, both governmental and private sector.
 - **Eliminate** filling private swimming pools.
 - **Require** the use of pool covers on all public swimming pools during non-use times.
 - **Reduce** the use of other water recreation facilities.

- **Reduce** the use of or close public and private swimming pools and other water recreation facilities
 - **Require** that ornamental fountains in buildings and parks be turned off.
 - **Impose** restrictions in landscape water use in proportion to the severity of the drought.
 - **Restrict** all outside irrigation, including park, golf course, school grounds, and local, state, regional, or national government irrigation.
 - **Restrict** water use in greenhouses and watering of nursery stock.
 - **Restrict** irrigation of private and community food, herb and flower gardens.
 - **Restrict** water use for fertilization, pesticide and herbicide application by commercial enterprises or by individuals.
 - **Prohibit** all new landscaping including planting of trees and shrubs.
 - **Prohibit** outdoor water use (as a last resort in an extremely severe drought) except for subsistence irrigation of trees and shrubs.
 - **Publish** more information on ways to minimize landscape damage and loss.
- ❖ **Monitor** drought response effectiveness, recommend adjustments quarterly to the Denver Water Board, report to the public regularly, and document results annually.

◇ SECTION THREE: PUBLIC OUTREACH



Listening and Talking

So far, this report has outlined a technical approach to drought response. It has provided a status report on water supply and use, as well as a point-by-point menu of options for reducing water use and temporarily increasing supplies. However, the plan remains incomplete.

The best analysis and most careful planning will be useless if Denver Water cannot effectively communicate about the drought, especially with its customers. Communication is the third part of the drought response triangle.



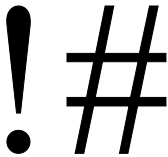
Effective communication requires the effort of everyone associated with Denver Water. Further, this communication cannot and should not be one-way—from this public agency outward. Denver Water must listen; a wide variety of audiences are affected by drought. Denver must engage people in an exchange, particularly if drought becomes moderate or severe. Without this approach, Denver cannot meet its prime goal of timely action that recognizes customer needs and yet responds so that customers' basic water needs can be met for the duration of a drought.

Any drought that affects Denver Water customers likely will affect the customers of other metro-area water suppliers. For this reason, Denver proposes to form or join a metro water suppliers drought response group as soon as possible. The group members would exchange drought response plans if they are available. There are two primary purposes of the metro drought response group:

1. To coordinate media communication.
2. To let other members know beforehand what drought response actions a given supplier is contemplating.

Coordination among metro-area water suppliers is crucial to avoid confusing the public. One concern is a possible “oasis effect” whereby the customers of one supplier have more available water than the customers of another, neighboring supplier. If one supplier is contemplating actions to reduce water use, other suppliers should be told beforehand. This coordination helps each supplier communicate clear, consistent information to its customers and the media.

Maintaining Credibility



Essential to this plan’s success is making sure people know about the potential or actual drought and what it could mean. Customers need assurance that:

- △ The drought is real.
- △ Denver Water is efficiently managing the existing water supply.
- △ Denver Water takes the inconvenience and sacrifice involved in drought response seriously; each Denver Water employee is experiencing it, too.
- △ All customers share inconvenience and hardship.

Credibly making these points takes effort beyond saying them. Denver Water must provide accurate and understandable information on the potential and actual effects of the drought, as well as on the drought plan and its goals. Denver Water’s ability to inform everyone of the water supply situation will determine the agency’s credibility throughout the drought period and beyond.

Making the Rounds with Early Information

- △ **Denver customers.** All customers, regardless of their contractual relationship with Denver Water, will need to understand Denver Water’s decision-making basis, why

drought action is needed, and what they might expect in future months if the drought continues. Denver Water's Distributors will be invited to meet with staff to determine timeframes for action of individual Distributor Boards of Directors and notification of customers. Master Meter Distributors will be required to have a plan of enforcement at this time, either handling all enforcement of restrictions themselves, or arranging with Denver Water for enforcement.

- △ **Homeowners' associations and neighborhood organizations.** Staff will ask to meet with the Inter-Neighborhood Cooperation (INC) board to present background and plans for dealing with drought. News items will be offered for incorporation into members' newsletters.
- △ **News reporters and editors.** The media will be one of the best vehicles for informing the public of conditions and plans.
- △ **Water users greatly affected by drought.** The landscaping and plumbing industries, the hospitality industry, developers and other high-water-using businesses will need special information about the drought and potential restrictions or rate increases that will affect their businesses more than average.
- △ **Local governments.** The metro-area drought response group mentioned on page 31 should enable local governments in the Denver area to keep each other informed about the water supply situation. Local governments need to know about possible impacts on citizens and potential restrictions on government water use. City councils will be provided in-depth information for their decision-making. Public agencies will need to lead the way and be the first to show a willingness to save, while maintaining public health and safety.
- △ **People who fish or use water for recreation.** A drought will lower reservoirs and, if severe enough, make many types of recreation more difficult. These groups need to be informed of current and potential conditions early in the process.
- △ **Denver Water employees.** Denver Water employees can be excellent water ambassadors and most helpful in answering public questions.
- △ **Western Slope communities and interest groups.** Denver Water will need to work closely with Western Slope communities whose economies may be affected by drought through a loss of in-state and out-of-state visitors.

Involving the Public in Drought Response Decisions



The Denver Water Citizens' Advisory Committee (CAC) is a standing nine-member group that monitors the agency, helps increase public awareness, invites public involvement, and advises the Denver Water Board on policies. The CAC's Drought Response Task Force encouraged the writing of this plan. As this plan is updated and

refined, the Task Force, the CAC as a whole, and other interested people will continue to review drought preparation work and provide feedback.

As a drought develops and people begin to anticipate the effects of dry conditions, public interest in this drought plan will increase. The goal is to have a good, usable plan in effect prior to any sign of drought. However, the plan may need to change to respond to specific conditions, including which enacted drought policies are working and which are not.

In the event of a drought, the CAC's Drought Response Task Force would be expanded to provide feedback on drought plans and policies. Staff will consult with the group to assess impacts on landscaping and plumbing industries (including HVAC businesses) and the public-at-large, including low-income customers, homeowners associations, Western Slope representatives, the recreation community, businesses, city agencies, and any other interested groups. This approach will help to monitor drought conditions and make recommendations on efforts to cut water use and communicate with customers and the general public.

Watching for Drought



If drier than normal conditions exist, public interest in drought potential will exist before Denver Water has the opportunity to make a reasonably certain projection of July 1 reservoir storage. The effects of lower snowfall amounts, reduced reservoir storage and increased forest fire dangers already will have generated a general awareness. In addition, other Denver metro-area water suppliers may have already imposed restrictions on their customers.

In the early stages of a dry period, it will be important to communicate that Denver Water is watching conditions on the Denver system closely. The public should know that Denver is ready to act when the situation specific to its water system and customers calls for action.

Even if dry conditions do not eventually lead to a drought declaration for customers of Denver Water, its Public Affairs staff and the members of the Board and CAC need to be prepared with consistent information to field queries from the media, customers and recreationists. As the issue emerges—well before potential drought declaration—Denver Water staff should:

- △ Convene Denver Water's Drought Response Committee to review conditions. Although other committee members may be added, the core committee should involve Denver Water's division directors and/or the specific staff members listed below:

Engineering Division
 Coordinator of Recreation
Finance Division
 Manager of Rates
Legal Division
Operations and Maintenance Division
 Superintendent of Source of Supply
 Manager of Water Quality
Planning Division
 Manager of Water Resources
 Manager of General Planning
 Manager of Raw Water Supply
Public Affairs Division
 Manager of Water Conservation
 Manager of Customer Services
 Manager of Community Affairs
 Manager of Media Relations
 Sales Administrator

- △ Name an internal drought coordinator from this committee to focus on all issues related to the potential drought, and to be the person assigned as leader of the effort.
- △ Keep customer service representatives well informed.
- △ Work with the State of Colorado Drought Task Force to share information among agencies and with the public.

Considering Policies During Drought

During a drought, the Denver Water Board will be faced with a variety of policy considerations. Among them:

- △ Other metro-area communities facing water shortages may approach Denver Water for additional supply, perhaps at early stages when it will not be clear if storage on Denver's system will drop to drought levels. The metro-wide water supplier drought group discussed on page 31 will coordinate public information and drought declarations in particular.
- △ At some point, the Board will be asked to consider the need for providing proper notice to temporarily suspend new tap permits.
- △ Because of the relative reliability of the Denver Water system, water use restrictions likely will be enacted for customers of some other water providers before Denver Water does so. This could put pressure on Denver Water to enact restrictions for its customers earlier.

- △ Effects on mountain reservoirs and stream flows will be one of the early issues. People who use bodies of water for recreation, as well as communities dependent on them for tourism, may want Denver Water to operate the system primarily to help ease their problems.
- △ As Denver's customers use less water, revenues will drop. In a drought, water rates might be increased to encourage conservation. As the drought eases, customers may or may not begin using water again in their previous patterns. Water rates may not return to their previous level. All extra revenue received from higher water rates during a drought will be tracked, and regular reports will be given to the Board.

Staging Public Outreach Efforts

As efforts are increased to cut water use and/or locate new water supplies, so should public outreach efforts intensify, as the following progressive menu of public outreach action options shows. At each stage, it is important for Denver Water to listen and remain open to opportunities to engage in an exchange.

Mild Drought

- *Actual or expected July 1 reservoir storage less than 80 percent full.*
- *Requests for voluntary conservation (beyond that requested continuously as part of the Denver Water Master Conservation Plan) to reduce consumption 10 percent.*
- Expand public involvement process immediately. Ask for help from the CAC in generating public involvement, as well as in reviewing the Denver Water Board's specific action plans and making recommendations.
- Increase public awareness of drought.
 - Explain supply conditions to customers and encourage extra conservation.
 - Specify the range of possible future restrictions, including penalties, if the drought worsens.
 - Provide advice on lawn care, including why people should avoid changing or starting new landscapes.
 - Provide advice on managing water-based air conditioning systems.
 - Offer suggestions to customers for dealing with higher air temperatures in offices, business and homes.
- Describe the drought's effects on streams and reservoirs.

- Develop media pieces to inform customers of the drought response plan. Offer interviews on radio and TV talk programs, write articles for publications, and create other opportunities for letting the public know about the drought.
- Keep customer service representatives well informed on drought conditions and the range of recommended voluntary conservation measures.
- Put drought information in water bills.
- Distribute fact sheets on drought topics such as supply conditions, weather facts, conservation tips, and the like.
- Make presentations on drought response at neighborhood, service and community meetings.
- Organize contests for new ideas on saving water. This also helps gauge public acceptance of possible future response measures if the drought worsens.
- Consistently update city officials. In particular, work with representatives of fire, parks and recreation, and public works departments to inform them of possible actions if drought worsens.
- Work with Western Slope interests, as well as fishing and recreation groups.
- Coordinate media communications with other water suppliers in the metro area.

Moderate Drought

- *Actual or expected July 1 reservoir storage less than 60 percent full.*
- *At this stage, Denver Water may impose mandatory measures as shown in the Drought Response Outline on pages 26 and 27.*
- Continue efforts from Mild Drought stage.
- Elevate public awareness of the drought's seriousness through the media.
- Increase distribution of brochures and fact sheets.
- Attend and hold more community meetings informing people of conditions and additional mandatory conservation measures.
- Hold a Drought Awareness Week to cover all issues and to seek new ideas.
- Encourage customers to send in water saving ideas and publicize efforts of heroes and heroines.

- Designate a telephone hotline dedicated to answering questions and concerns about drought.
- Develop a slogan for community drought response.
- Ask for volunteers to help carry the message about drought response. They could look for water-saving ideas, speak to neighborhood groups, staff the telephone hotline, and implement other activities.
- Continue to communicate with parties greatly affected by the drought, including Western Slope communities, businesses, recreationists, and city and state officials.

Severe Drought

- *Expected or actual July 1 storage less than 40 percent full.*
 - *At this stage, restrictions and enforcement may be severe as shown in the Drought Response Outline on pages 28 through 30.*
- Expand on written materials and brochures.
 - Continue efforts from Mild and Moderate Drought stages.
 - Increase media outreach. Respond to frustrations on restrictions. Meet with editorial boards for opinion page coverage.
 - Hold a conservation event to increase contact with the public.
 - Continue to meet with parties heavily affected by the drought to discuss their concerns.

◇ Summary

While it is impossible to predict exactly when a drought will come, how much water will be needed and what specific methods must be used to achieve savings, Denver Water is committed to communicating with its customers. Denver wants its customers and stakeholders, as much as possible, to understand the conditions and the challenges. This Drought Response Plan is offered in the spirit of openness and preparedness. The Denver Water Board's drought response decisions will be based on the specific circumstances during the drought and cannot be known with certainty ahead of time. This plan is intended to help staff, customers, stakeholders and the Board better prepare for the eventual drought.

◇ Glossary of Terms

Aggregate Flow -- Total or combined flow.

Aggregate Raw Water Storage -- The total amount of raw water stored in a system of reservoirs. Also called Aggregate Reservoir Storage.

Dead Storage -- The water in the bottom of a reservoir, below the outlet, that can only be removed by pumping.

Demand -- The amount of water customers would use without any restrictions placed on that use.

Diversion Point -- A place on a river or creek from which water is diverted.

Drought -- 1. An extended period of below-average precipitation and/or stream flow that stresses customers' water supply (Denver Water's Definition). 2. A long period of below-average precipitation. 3. The time period in which a shortfall of precipitation creates a shortage of water, whether for crops, utilities, municipal water supplies, recreation, wildlife or other purposes (from National Drought Mitigation Center). 4. A temporary deviation from normal patterns of precipitation and/or human activities such as population growth, irrigation, environmental awareness and changing laws, all of which reduce the amount of water available.

Firm Yield (also Firm Annual Yield) -- The yearly amount of water that can be dependably supplied from the raw water sources of a given water system.

Gray Water -- Water that is not brought up to drinking water quality standards, but is good enough for irrigation. The source of this water is usually clean but wasted water that runs down drains in sinks and showers and tubs, but not toilets.

Interruptible Supply Contract -- A legal agreement between Denver Water and another entity outside the City and County of Denver that promises water services most of the time, except when certain conditions, like drought, make it impossible to continue that service. Thus, the water service is interrupted.

Minimum Bypass -- The lowest allowable amount of water released from a reservoir or allowed to flow past a diversion structure.

Nontributary Well -- A well that has an underground supply that is not fed by a river, creek, stream or any other waterway to which others have water diversion rights.

Recurrence Interval -- A phrase that means the same thing as “return period.”

Return Period -- The average interval in years between the occurrence of a hydrologic event (such as a flood or drought) of a specified magnitude and an equal or more severe event. For example, saying that the drought of 1953-1956 has a return period of 16 years means that, on the average, one could expect a four-year dry period as bad or worse than 1953-1956 every 16 years.

Subsistence Irrigation -- The amount of water applied by humans to landscape that keeps the plants alive, but is not adequate to help the plants thrive and grow.

Synthetic Streamflow -- A streamflow record generated by statistical methods that is longer than the observed streamflow record but has similar statistical properties. Synthetic streamflows often are used to estimate the probabilities of extreme events such as floods and droughts when the record of observed streamflows is relatively short.

Untransformed stream flows -- Stream flows that have **not** been mathematically transformed in order to analyze them statistically.

Virgin Streamflow -- The flow at a point in a stream that would be present without any influence by humans. Unregulated streamflow.

◇ Index

A

Air conditioning, 4, 29, 37
Annual use, 1, 12, 21
Audits, 3, 27

B

Board of Water Commissioners, 1, 2, 3, 5
Buildings, 4, 29, 30

C

Car washing, 3, 4, 27, 29
Chatfield Reservoir, 15
Citizens' Advisory Committee, 2, 5, 16, 34
Conservation Plan, 11, 36

D

Demand
 average annual, 1, 9, 21
 defined, 10, 40
 reduction, 22
 treated water, 12
Developers, 33
Distributors, 2, 3, 24, 25, 33
Driveways, 4, 29
Drought
 assessment process, 16, 20
 declarations, 2, 17-22, 34, 35, 36
 defining, 1, 6, 7
 example, 20
 hotline, 3, 11, 26
 levels/stages, 1, 3, 14, 16, 19-23, 26, 35, 36, 38
 Response Committee, 35
 Response Task Force, 5, 34
 severity, 5
 tradeoffs, 21
 triggers, 1, 14, 17, 21, 22

F

Faucet aerators, 4, 29
Fire
 department, 3, 26
 fighting, 16
 forest, 34
 hydrant, 4, 29
Firm yield, 1, 9, 10, 17, 22, 40
Fountains, 4, 30

G

Gardens, 5, 30
Golf course irrigation, 5, 30
Government, 2, 3, 5, 14, 26, 27, 30, 33
Gray water, 4, 29, 40
Greenhouse, 5, 30

J

July 1 declaration, 1, 17, 18, 19, 20

L

Landscape
 mild drought, 2, 24, 37
 post-drought revival, 5, 28
 severe drought, 4, 28, 30
Lawns, 3, 11, 16, 19, 22, 26, 37
Leak detection, 3, 11, 27
Legal, 2, 4, 15, 29, 40
Lowry Air Force Base, 12

M

Master meter, 3, 25, 27, 33
Media, 4, 28, 32, 33, 34, 35, 37, 38
Moratorium on new taps, 4, 28

N

Natural streamflow, 7

O

Oasis effect, 32
Outdoor water use, 2, 3, 4, 5, 24, 26, 29, 30

P

Park irrigation, 5, 10, 30
Penalties, 3, 4, 26, 28, 29, 36
Platte Valley, 12

R

Rate increase, 2, 16, 24, 33
Recreation, 4, 6, 10, 21, 24, 29, 30, 33, 34, 35, 36, 37, 40
Requirements, 4, 26, 28
Restaurants, 4, 29
Revenues, 2, 16, 24, 36
River call, 15

S

Seed, 3, 26
Showerheads, 4, 29
Sidewalk washing, 4, 29
Snow pack, 1, 18, 19, 20
Sod, 3, 26
Stapleton, 12
Street cleaning, 4, 29
Swimming pools, 4, 29, 30

T

Tree farms, 5

W

Weather, 1, 9, 10, 11, 16, 20, 22, 37
Wells, 2, 15
Western Slope, 5, 33, 34, 37, 38
Williams Fork Reservoir, 15

X

Xcel Energy, 15
Xeriscape, 16